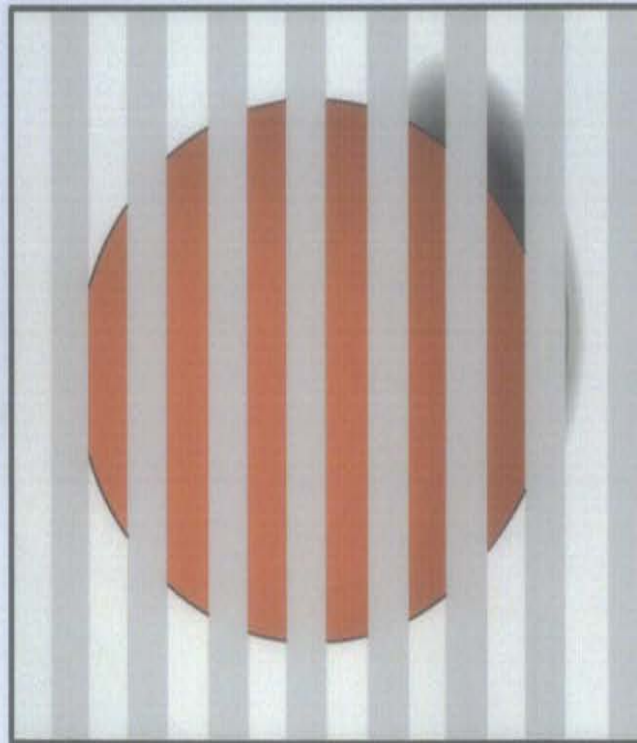


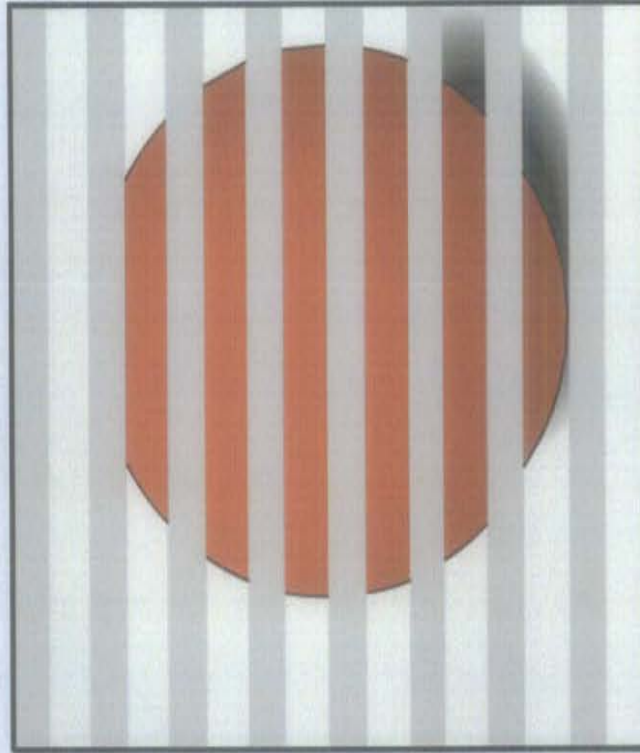
Coding Interlaced Video As Interlaced Frames Presented Problems

The Bottom Field is captured $1/60^{\text{th}}$ of a second after the Top Field

Top Field



Bottom Field



SLIDE
6



FRAME
731

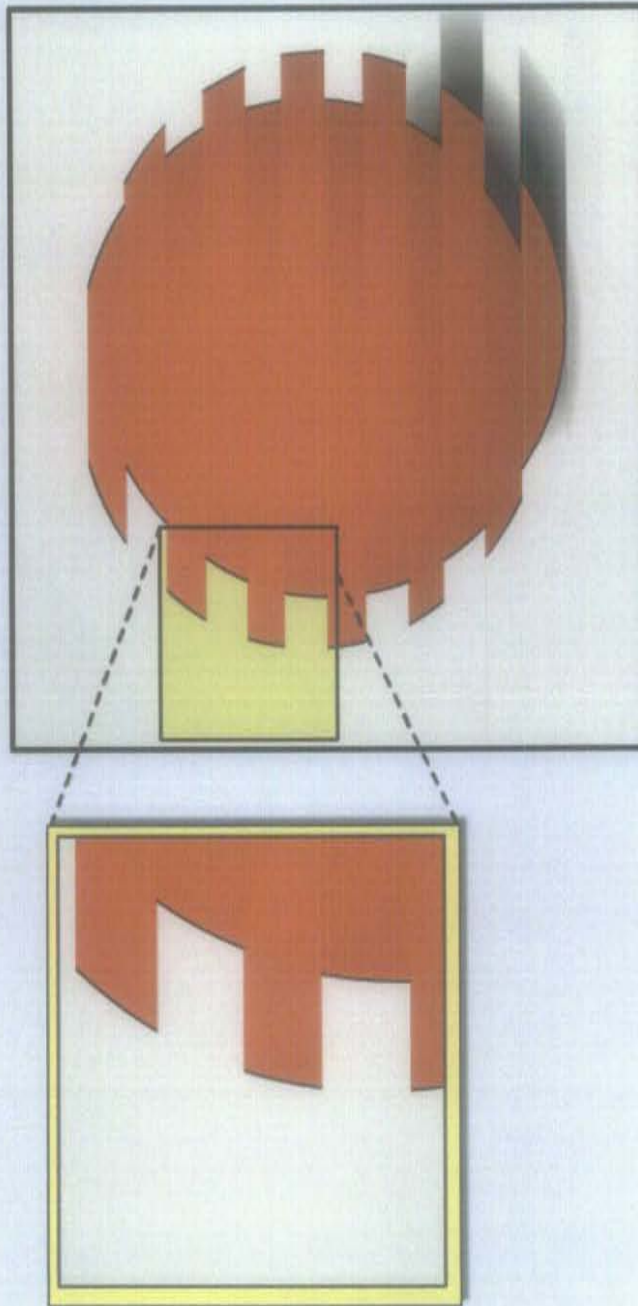


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Coding Interlaced Video As Interlaced Frames Presented Problems

In FRAME MODE, the two fields are combined.
When two fields are combined, a “combing” effect occurs



Index



FRAME
785

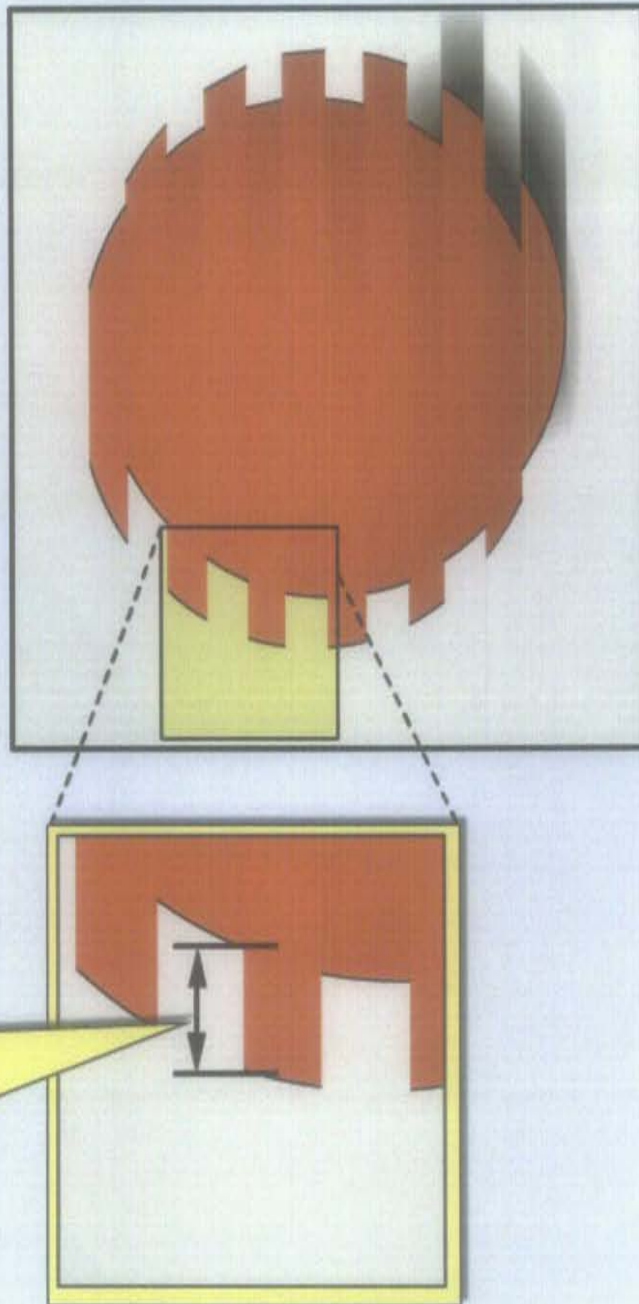


SLIDE
6



Coding Interlaced Video As Interlaced Frames Presented Problems

The jagged edge is caused by the motion of the ball and the delay in capturing the second field.
The ball moves this much from one field to the next ($1/60$ th of a second).

[Index](#)FRAME
786SLIDE
6

AFF Coding On Single Macroblocks Presented Problems

In FRAME MODE, the two fields are coded jointly. The "combing" effect results in less efficient compression.



SLIDE

6

FRAME

787

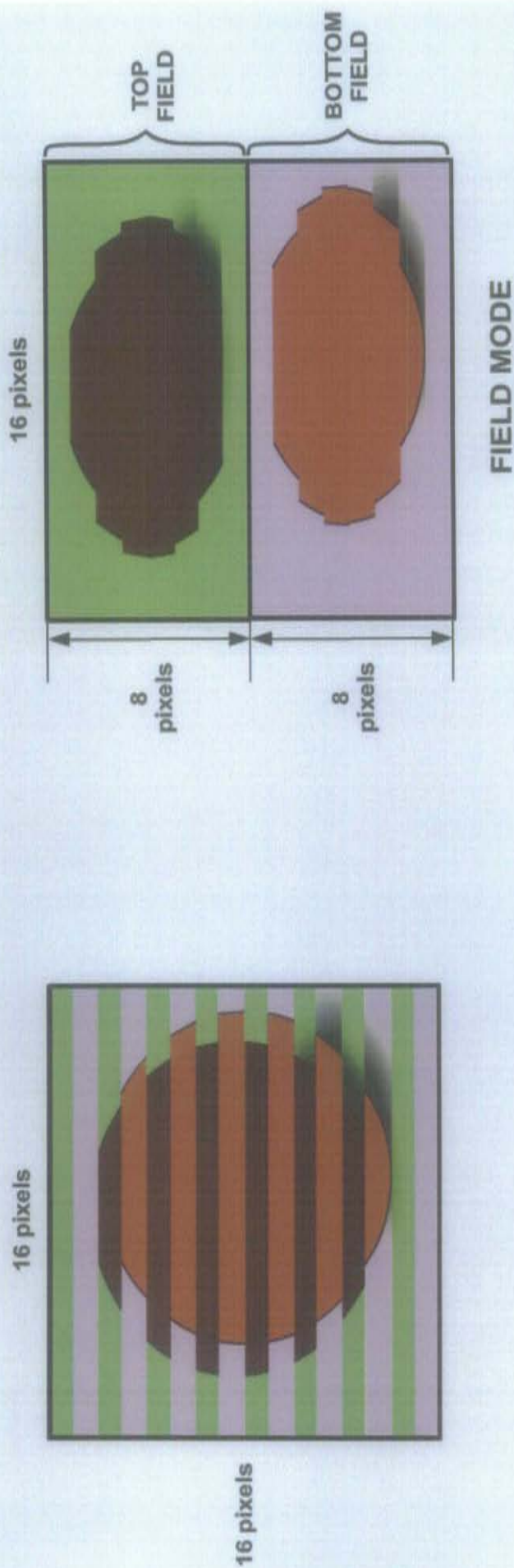


Index



AFF Coding On Single Macroblocks Presented Problems

In FIELD MODE encoding, a macroblock is split into a TOP FIELD and a BOTTOM FIELD. The two fields are then encoded separately. This results in more efficient compression.



SLIDE

6

FRAME

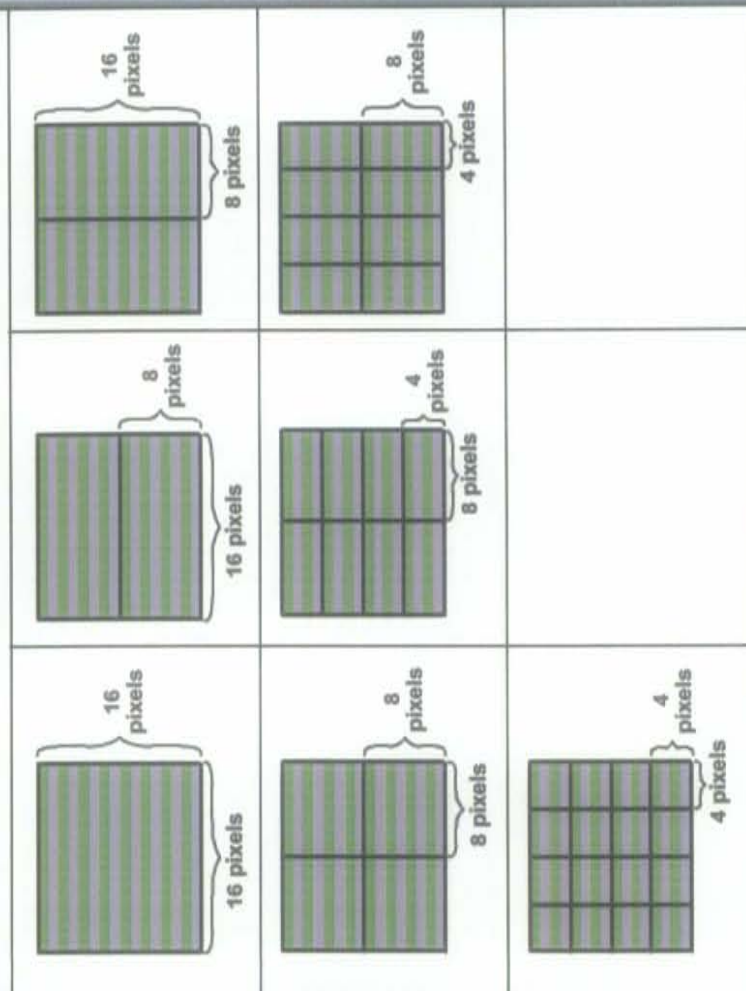
1066

Index

AFF Coding On Single Macroblocks Presented Problems

In FRAME MODE, the macroblock can be divided into seven different block sizes

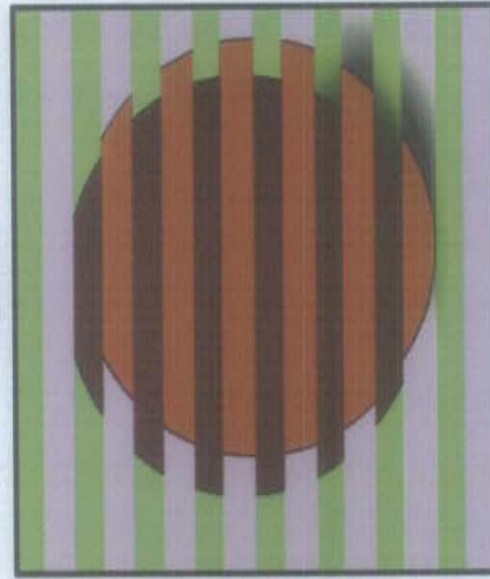
Macroblock Division Options



Once encoded as a frame, the macroblock can be further divided into the smaller blocks of FIGS. 3a-f for use in temporal prediction with motion compensation algorithm.

'374 Patent, 7:1-3

16 pixels



FRAME MODE

SLIDE

6

FRAME

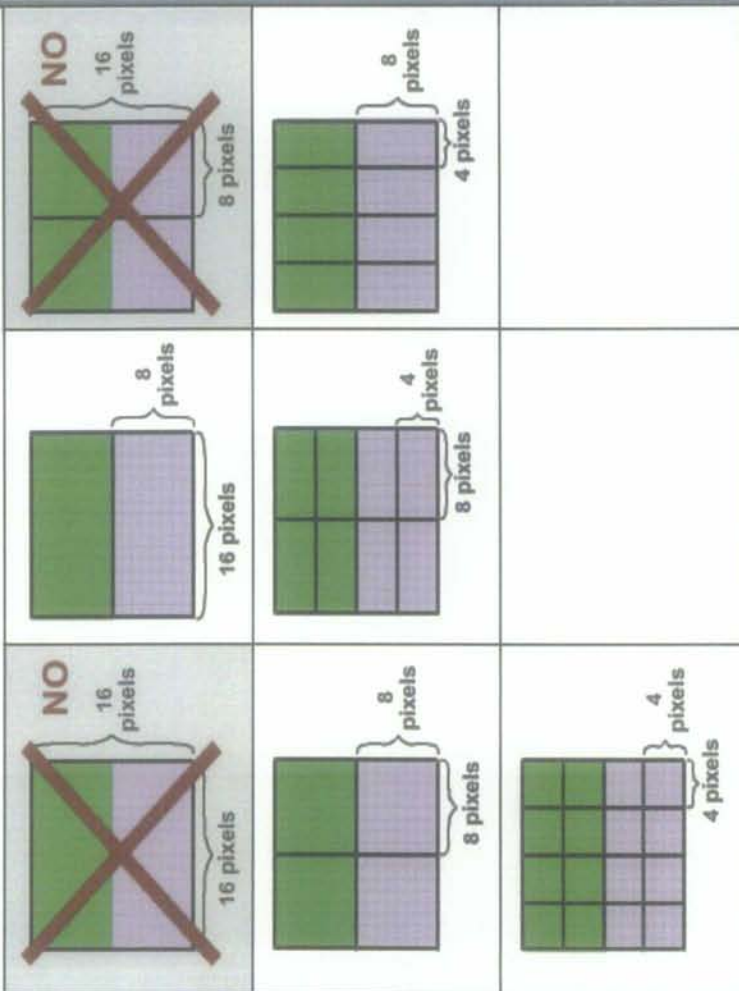
1110

Index

AFF Coding On Single Macroblocks Presented Problems

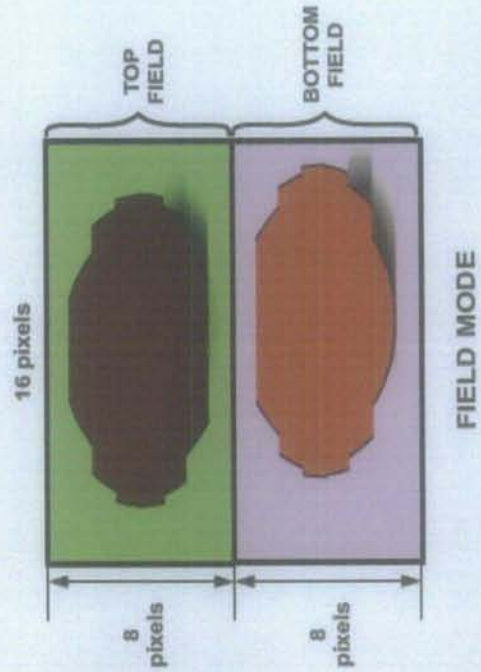
In FIELD MODE, the macroblock can be divided into only five different block sizes because a single block cannot comprise both top and bottom fields. Prediction performance suffers.

Macroblock Division Options



"The block sizes of 16 by 16 pixels, 8 by 16 pixels ...are not available for a macroblock encoded in field mode because of the single parity requirement. This implies that the performance of single macroblock based AFF may not be good for some sequences or applications that strongly favor field mode coding."

'374 Patent, 7:32-37



SLIDE

6

FRAME

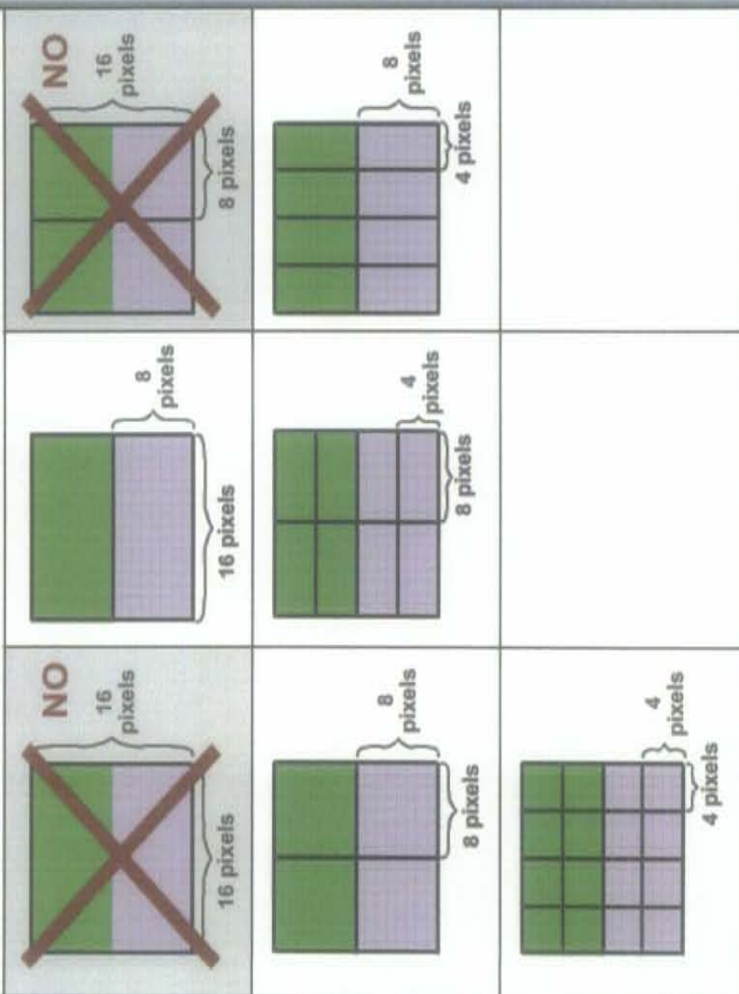
1111

Index

AFF Coding On Single Macroblocks Presented Problems

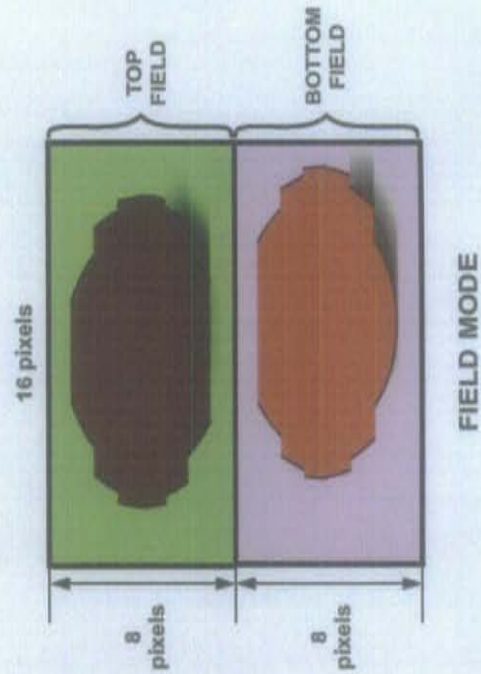
The problem: How to code objects in motion most efficiently by getting the benefits of **FIELD CODING** and the flexibility of all 7 block sizes.

Macroblock Division Options



"The block sizes of 16 by 16 pixels, 8 by 16 pixels ...are not available for a macroblock encoded in field mode because of the single parity requirement. This implies that the performance of single macroblock based AFF may not be good for some sequences or applications that strongly favor field mode coding."

'374 Patent, 7:32-37



SLIDE

6

FRAME

1112

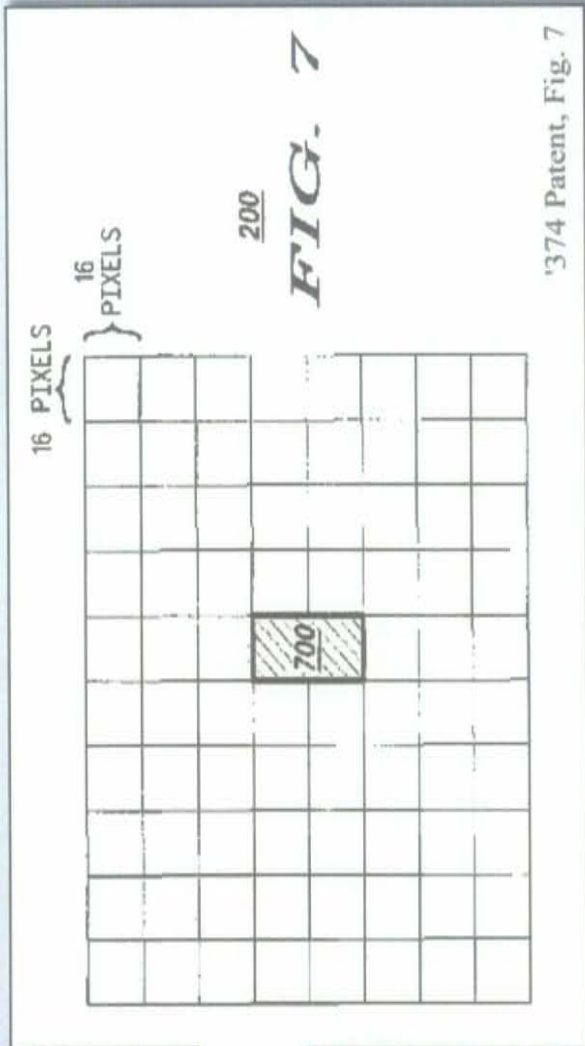
Index

AFF Coding On Pairs Of Macroblocks Solved Those Problems

The solution: One embodiment of the claimed invention is to perform coding on macroblock pairs instead of on a single macroblock. This allows for all the same options of macroblock subdivisions for both **FRAME MODE** and **FIELD MODE**.

“In order to guarantee the performance of field mode macroblock coding, it is preferable in some applications for macroblocks that are coded in field mode to have the same block sizes as macroblocks that are coded in frame mode. This can be achieved by performing AFF coding on macroblock pairs instead of on single macroblocks.”

'374 Patent, 7:37-43

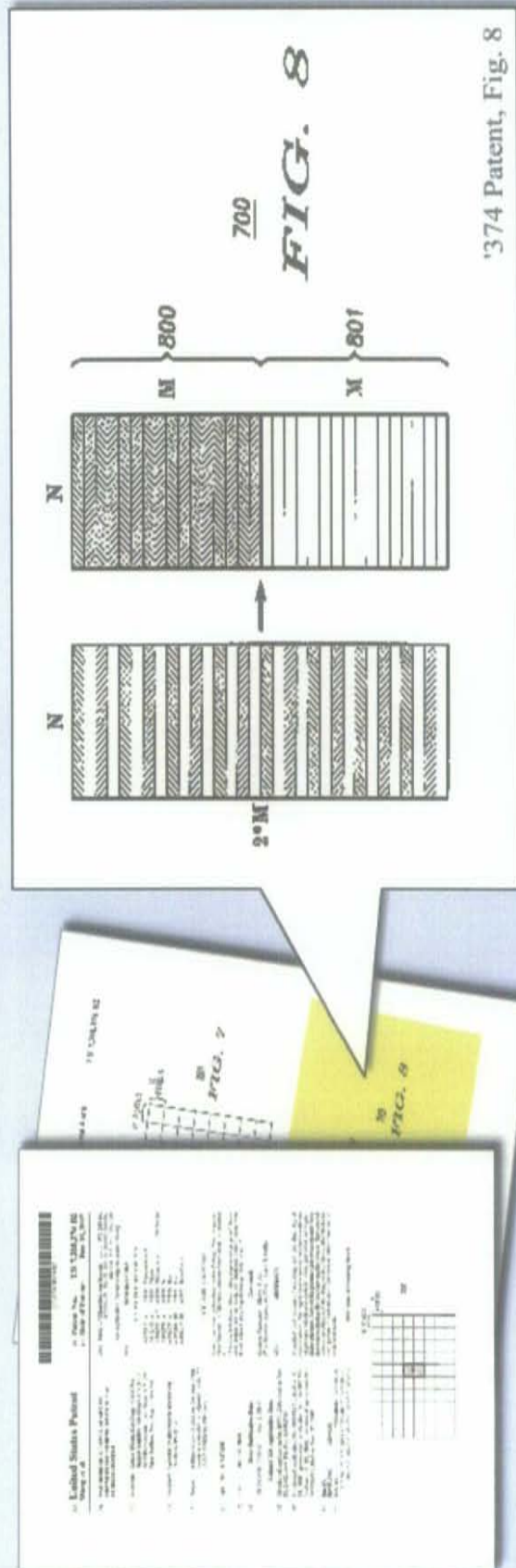


AFF Coding On Pairs Of Macroblocks Solved Those Problems

The solution: One embodiment of the claimed invention is to perform coding on macroblock pairs instead of on a single macroblock. This allows for all the same options of macroblock subdivisions for both FRAME MODE and FIELD MODE.

"In order to guarantee the performance of field mode macroblock coding, it is preferable in some applications for macroblocks that are coded in field mode to have the same block sizes as macroblocks that are code in frame mode. This can be achieved by performing AFF coding on macroblock pairs instead of on single macroblocks."

'374 Patent, 7:37-43



SLIDE

6

FRAME

1125

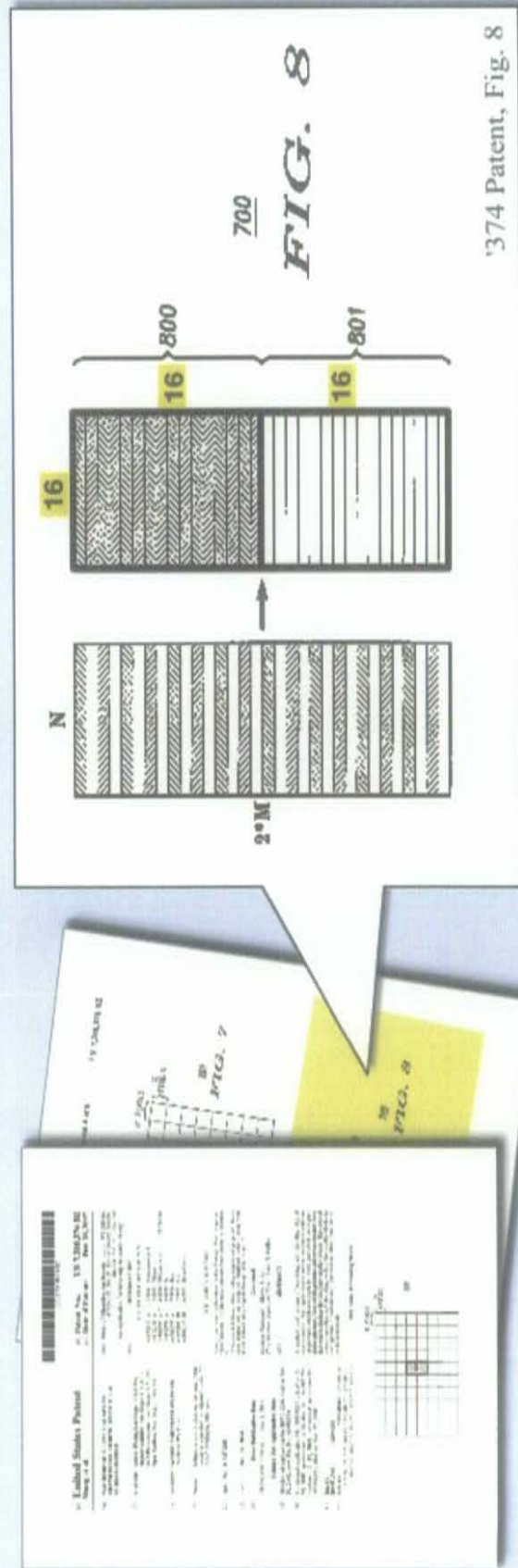
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AFF Coding On Pairs Of Macroblocks Solved Those Problems

The solution: One embodiment of the claimed invention is to perform coding on macroblock pairs instead of on a single macroblock. This allows for all the same options of macroblock subdivisions for both FRAME MODE and FIELD MODE.

“In FIG. 8, each macroblock in the pair of macroblocks (700) has $N=16$ columns of pixels and $M=16$ rows of pixels. Thus, the dimensions of the pair of macroblocks (700) is 16 by 32 pixels.”

'374 Patent, 7:58-61



SLIDE

6

FRAME

1126

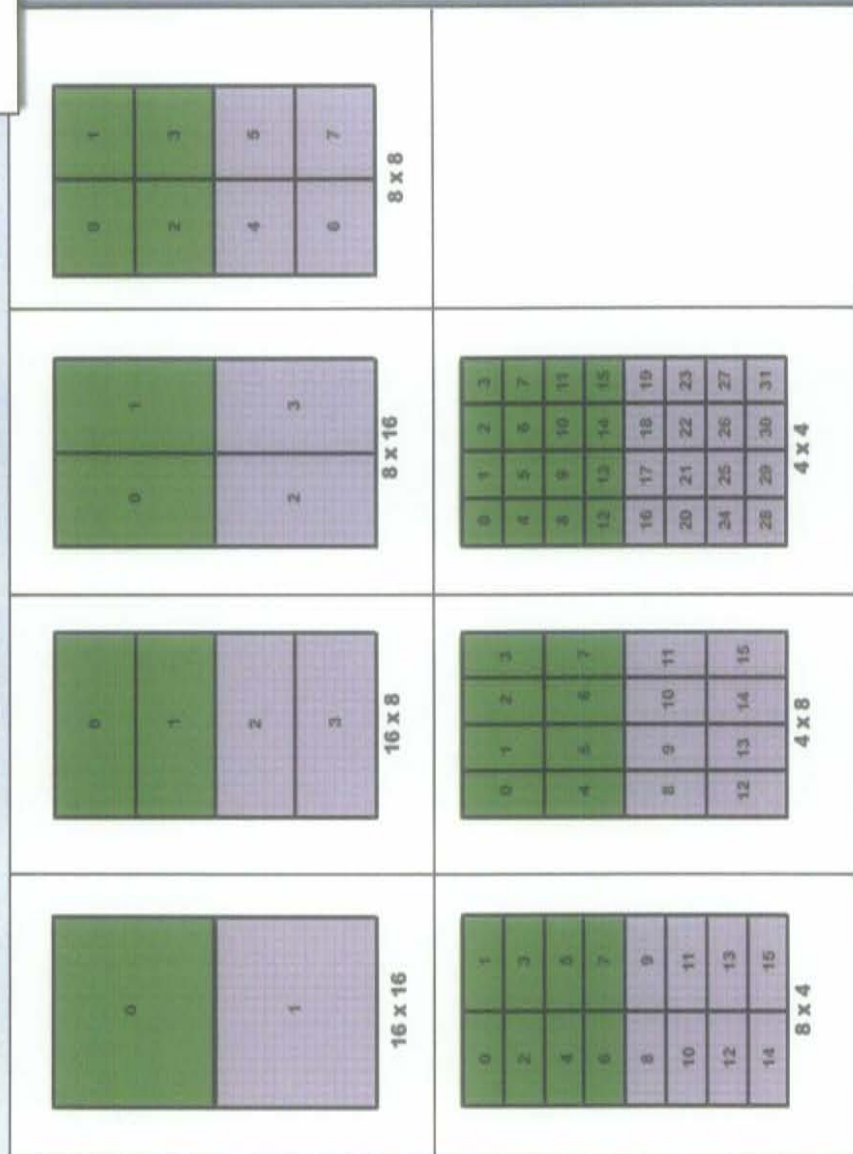
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AFF Coding On Pairs Of Macroblocks Solved Those Problems

With Motorola's invention, all 7 block size options are available in FIELD MODE.

The top field block (800) and the bottom field block (801) can now be divided into one of the possible block sizes of FIGS. 3a-f.

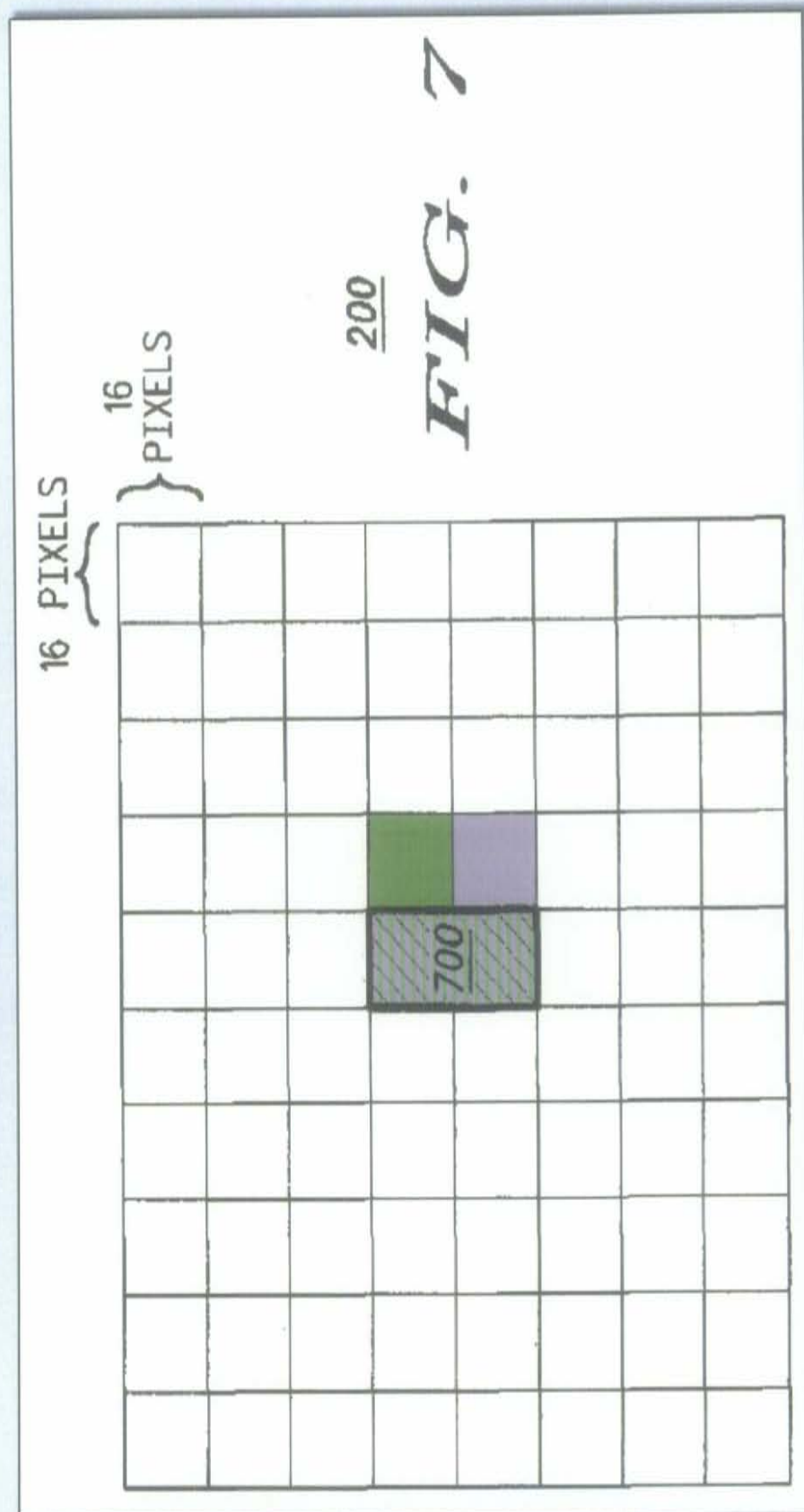
'374 Patent, 7:65-67



ECF No. 160-2, Ex. K, Fig. 17

Macroblock Pair
In Field Mode

AFF Coding On Pairs Of Macroblocks Solved Those Problems



SLIDE

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FRAME

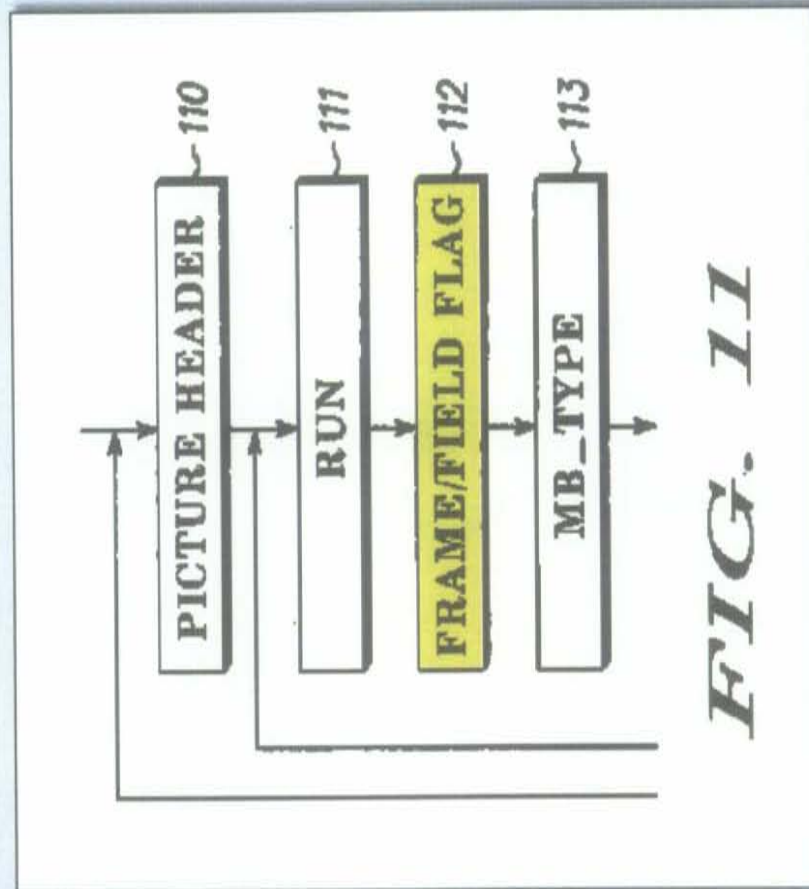
1445

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Frame/Field Flag Indicates Which Mode, Frame Or Field, Is Used In Coding

In AFF coding at the macroblock level, a frame/field flag bit is preferably included in a picture's bitstream to indicate which mode, frame mode or field mode, is used in the encoding of each macroblock. The bitstream includes information pertinent to each macroblock within a stream, as shown in FIG. 11. ... If the AFF is performed on pairs of macroblocks, the frame/field flag (112) is preferably included before each pair of macroblock in the bitstream.

'374 Patent, 8:46-58



Motorola's macroblock adaptive frame/field (MBAFF) coding invention was adopted into the H.264 Standard

When macroblock-adaptive frame/field decoding is in use, the picture is partitioned into slices containing an integer number of macroblock pairs as shown in Figure 6-8. Each macroblock pair consists of two macroblocks.

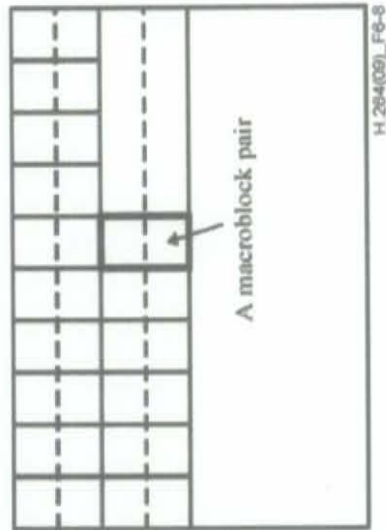


Figure 6-8 – Partitioning of the decoded frame into macroblock pairs

Dkt. 163-1, Ex. X, H.264 Standard, p.25

Motorola's macroblock adaptive frame/field (MBAFF) coding invention was adopted into the H.264 Standard

When macroblock-adaptive frame/field decoding is in use, the picture is partitioned into slices containing an integer number of macroblock pairs as shown in Figure 6-8. Each macroblock pair consists of two macroblocks.

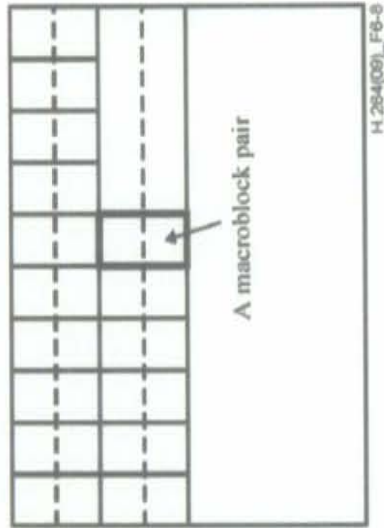


Figure 6-8 – Partitioning of the decoded frame into macroblock pairs

Dkt. 163-1, Ex. X, H.264 Standard, p.25



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The '374, '375 and '376 Patents

**The Asserted Patents are directed to Motorola's
MBAFF Invention together with:**

- **Inter coding ('374)**
- **Intra coding ('375)**
- **Scanning Paths ('376)**

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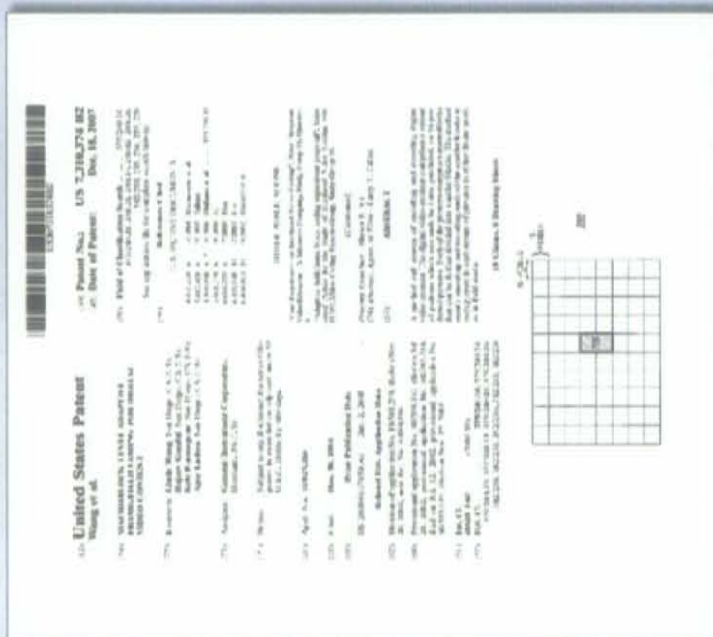


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The '374 Patent Claims Are Directed To The MBAFF Invention Together With Inter Coding

Inter coding is coding a picture by referring to reference pictures (i.e., pictures earlier or later in time) in order to predict the values of a block of pixels.



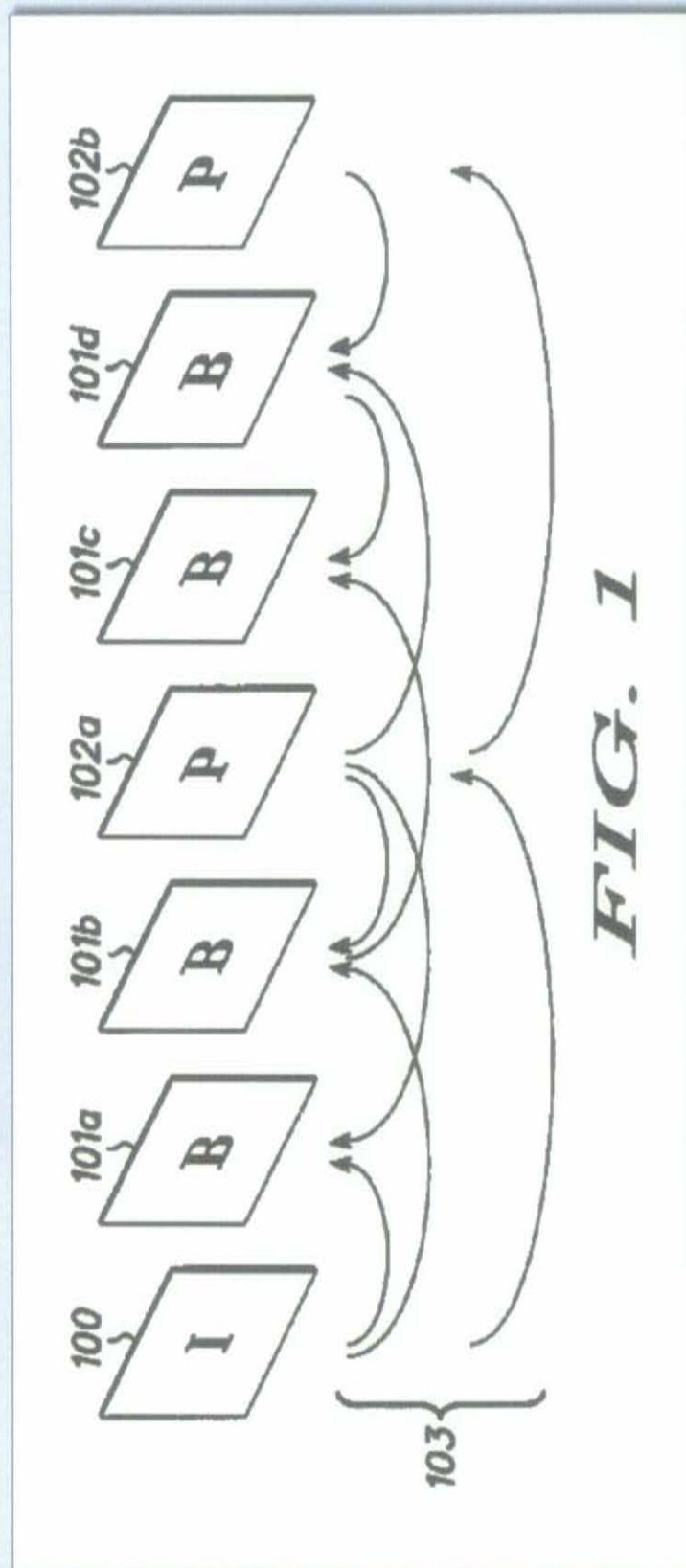
“According to an embodiment of the present invention, each frame and field based macroblock in macroblock level AFF can be intra coded or inter coded. ... On the other hand, in inter coding, temporal prediction with motion compensation is used to code the macroblocks.”

’374 Patent, 9:9-15

Inter Coding: Encoding A Macroblock In A Predicted Picture By Referring To A Similar Macroblock In A Reference Picture

A predicted picture (102a, b) is encoded using an I, P, or B picture that has already been encoded as a reference picture.

'374 Patent, 5:16-18



SLIDE

10

FRAME

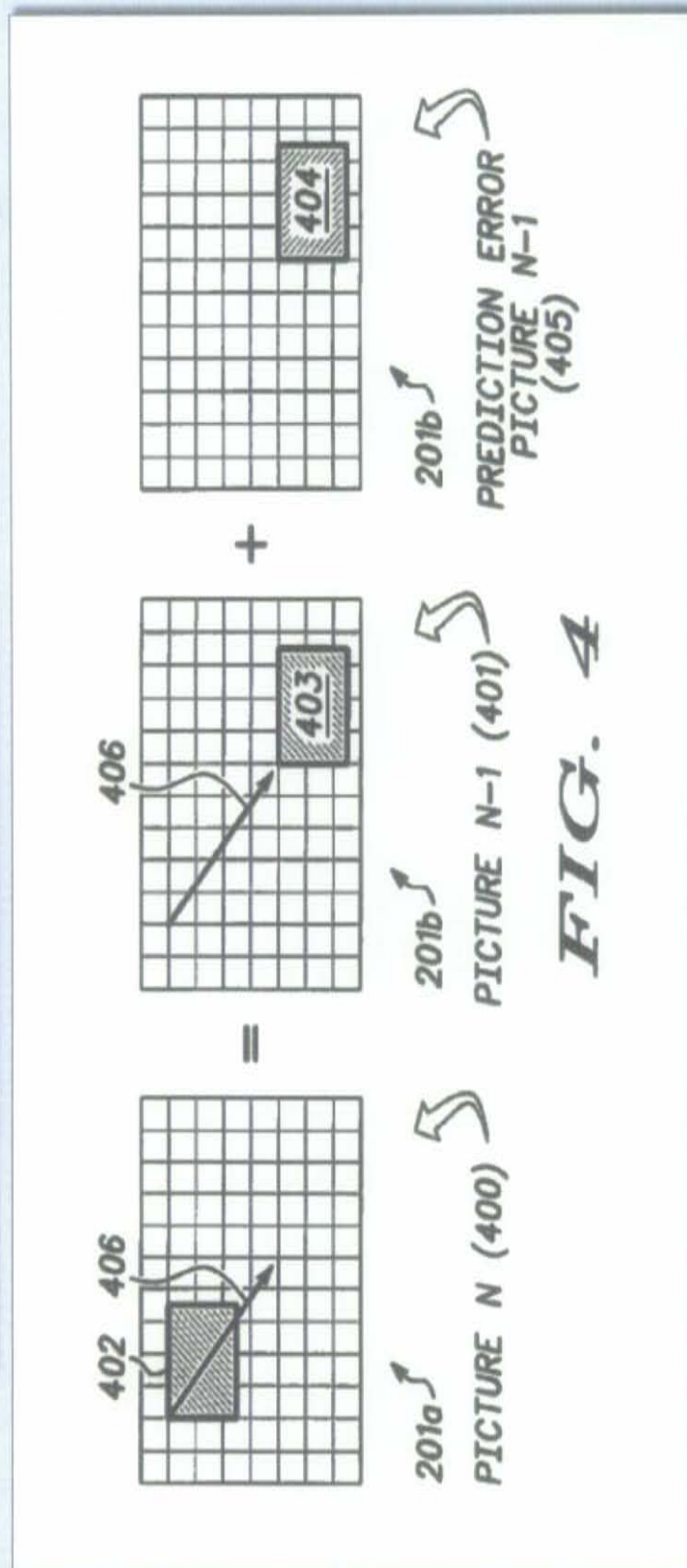
1

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Inter Coding: Temporal Prediction With Motion Vectors

For each image (402) in picture N (400), the temporal prediction can often be described by motion vectors that represent the amount of temporal motion required for the image (403) to move to a new temporal position in the picture N (402).

'374 Patent, 6:25-29



SLIDE

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FRAME

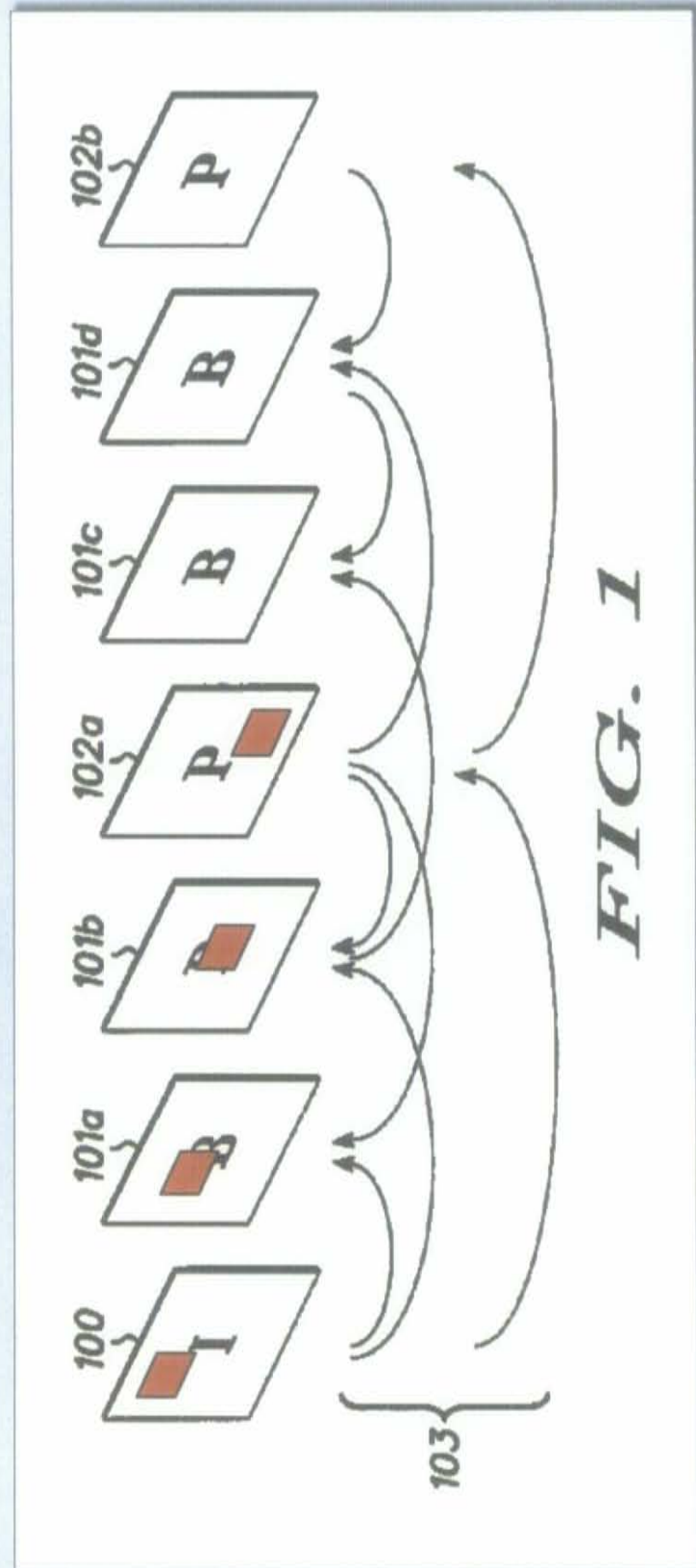
2



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Inter Coding: Temporal Prediction With Motion Vectors



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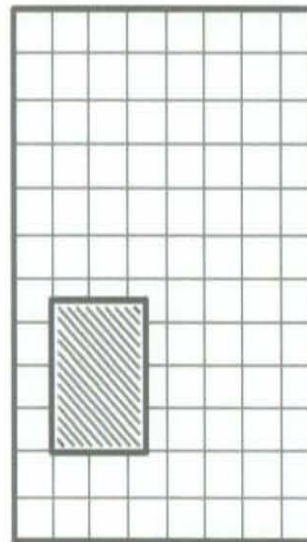
10

FRAME

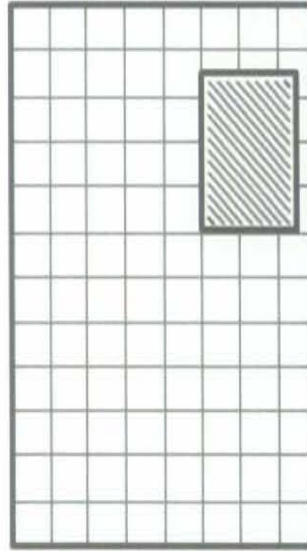
70



Inter Coding: Temporal Prediction With Motion Vectors



Reference Picture



Predicted Picture



SLIDE
10



FRAME
169

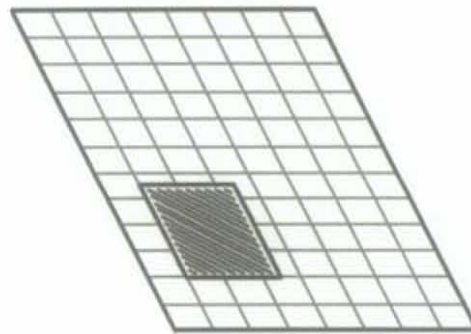


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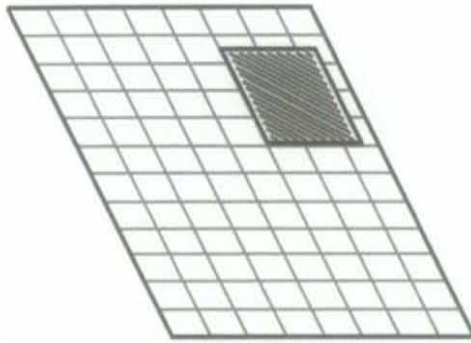


Inter Coding: Temporal Prediction With Motion Vectors

Image in Predicted Picture is predicted from image in Reference Picture



Reference Picture



Predicted Picture



SLIDE
10



FRAME
210

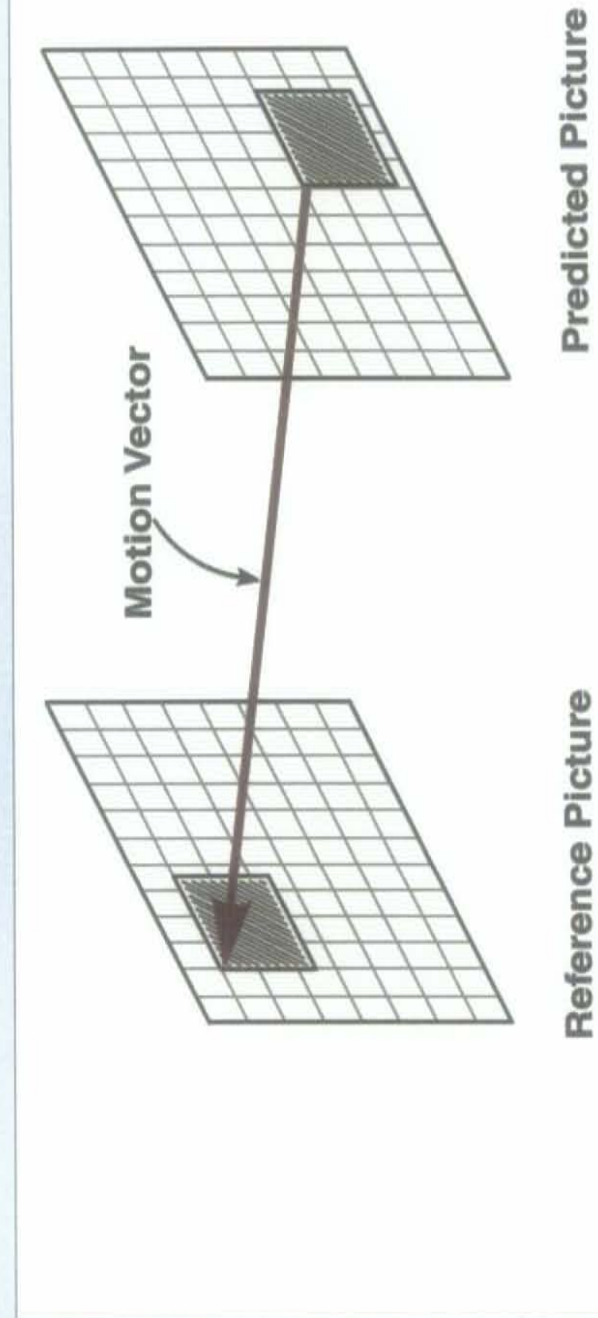


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Inter Coding: Temporal Prediction With Motion Vectors

Motion Vector points to the image
in the Reference Picture



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10



FRAME
242

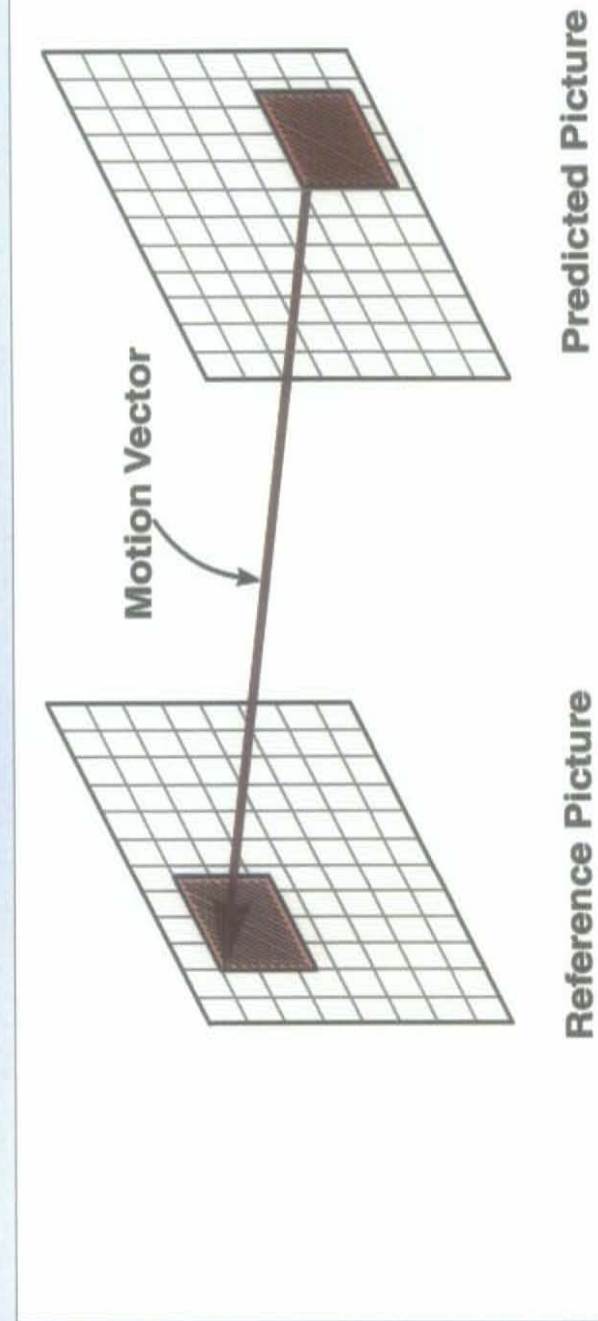


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Inter Coding: Temporal Prediction With Motion Vectors

A motion vector is used to predict the image from a corresponding image in the reference picture

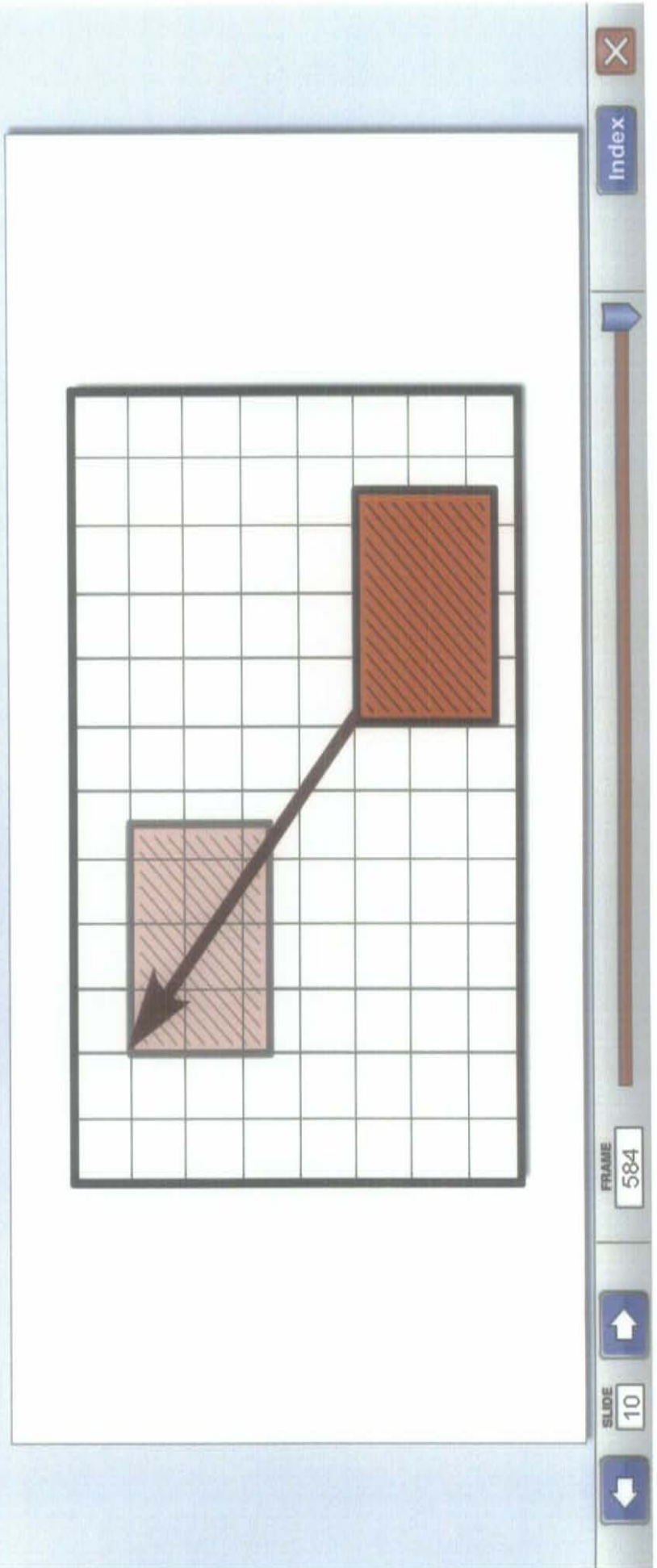
SLIDE
10FRAME
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Inter Coding: Temporal Prediction With Motion Vectors

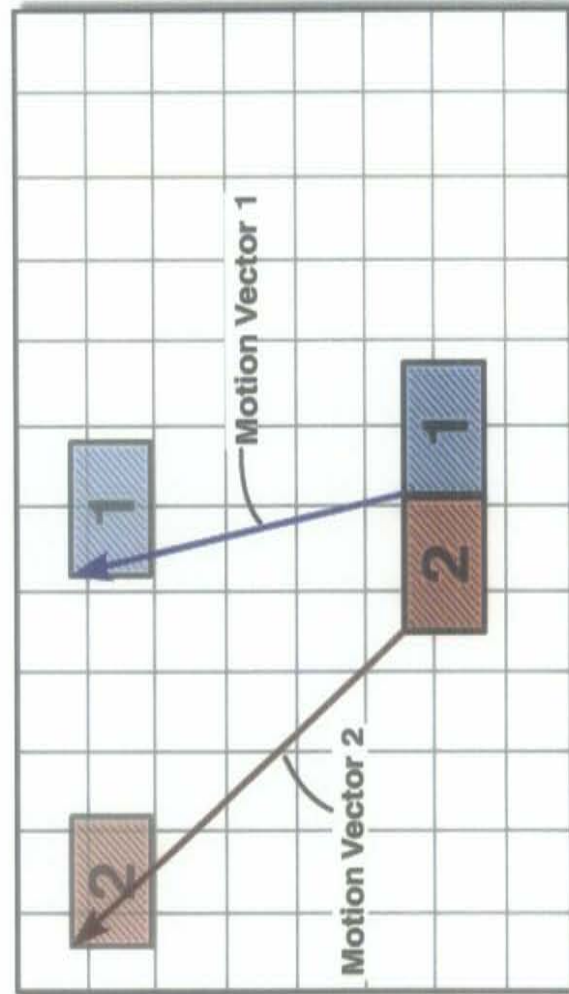
A motion vector is used to predict the image from a corresponding image in the reference picture



Motion Vectors Can Be Spatially Predictive Coded

The motion vectors are spatially predictive coded.... [I]n inter coding, prediction motion vectors (PMV) are also calculated for each block. The algebraic difference between a block's PMVs and its associated motion vectors is then calculated and encoded. This generates the compressed bits for motion vectors.

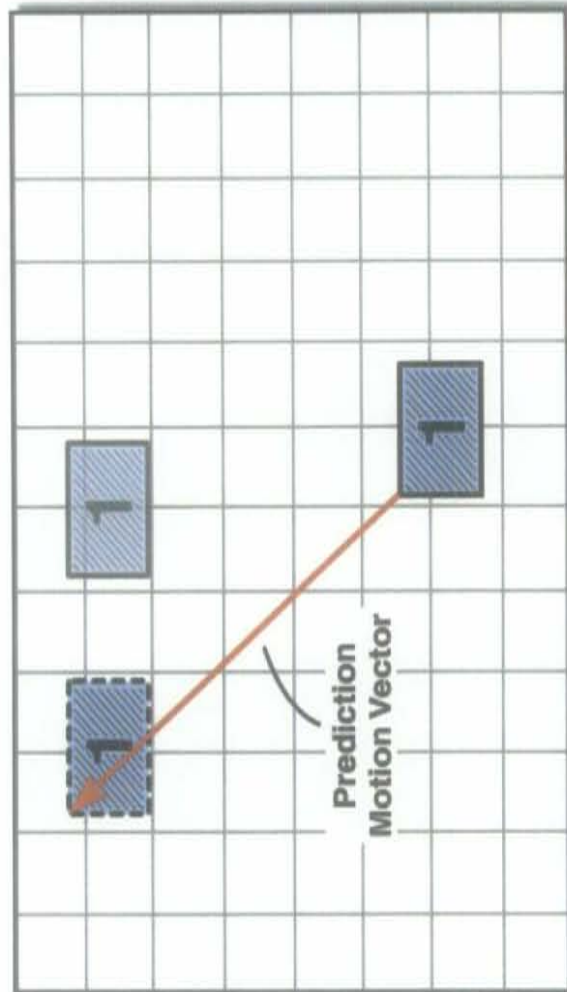
'374 Patent, 9:39-45



Motion Vectors Can Be Spatially Predictive Coded

The motion vectors are spatially predictive coded.... [I]n inter coding, prediction motion vectors (PMV) are also calculated for each block. The algebraic difference between a block's PMVs and its associated motion vectors is then calculated and encoded. This generates the compressed bits for motion vectors.

'374 Patent, 9:39-45



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FRAME
222



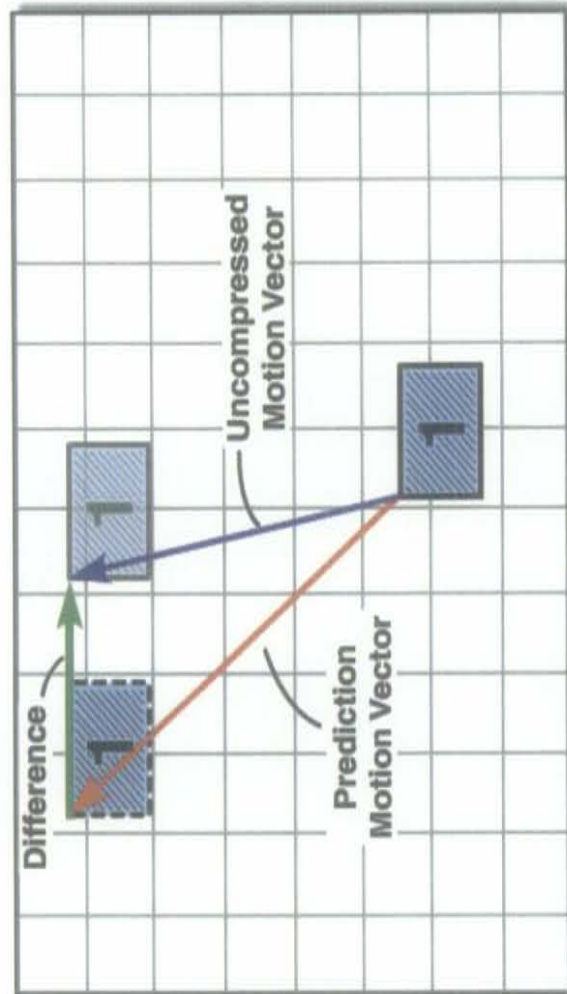
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Motion Vectors Can Be Spatially Predictive Coded

The motion vectors are spatially predictive coded.... [I]n inter coding, prediction motion vectors (PMV) are also calculated for each block. The algebraic difference between a block's PMVs and its associated motion vectors is then calculated and encoded. This generates the compressed bits for motion vectors.

'374 Patent, 9:39-45



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FRAME
283

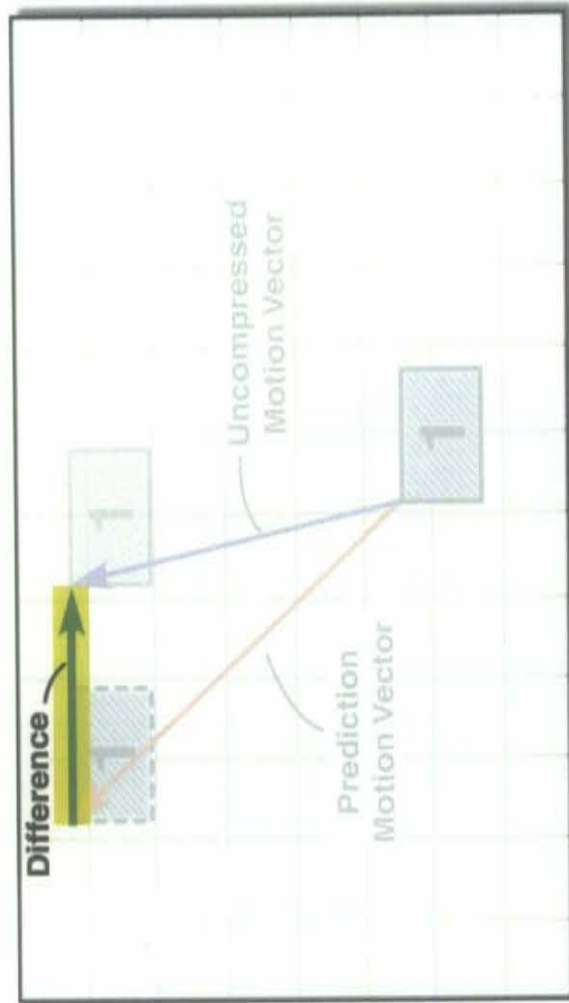
SLIDE
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Motion Vectors Can Be Spatially Predictive Coded

The motion vectors are spatially predictive coded.... [I]n inter coding, prediction motion vectors (PMV) are also calculated for each block. The algebraic difference between a block's PMVs and its associated motion vectors is then calculated and encoded. This generates the compressed bits for motion vectors.

'374 Patent, 9:39-45



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FRAME
305

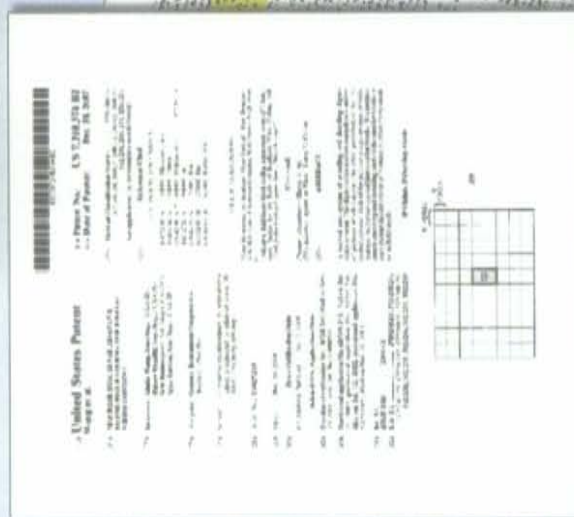


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The '375 Patent Claims Are Directed To The MBAFF Invention Together With Intra Coding

Intra coding is coding a picture without referring to reference pictures (*i.e.*, pictures earlier or later in time) by predicting the values of a block of pixels based on pixels from neighboring blocks within the same picture.



“According to an embodiment of the present invention, each frame and field based macroblock in macroblock level AFF can be intra coded or inter coded. In intra coding, the macroblock is encoded without temporally referring to other macroblocks.”

’374 Patent, 9:9-13

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In Intra Coding, A Block Is Coded Using Pixels In Neighboring Blocks

Q	A	B	C	D	E	F	G	H
I	a	b	c	d				
J	e	f	g	h				
K	i	j	k	l				
L	m	n	o	p				
M								
N								
O								
P								

FIG. 14

“For intra_{4x4} mode, the predictions of the pixels in a 4 by 4 pixel block, as shown in FIG. 14, are derived from its left and above pixels. In FIG. 14, the 16 pixels in the 4 by 4 pixel block are labeled a through p. Also shown in FIG. 14 are the neighboring pixels A through P. The neighboring pixels are in capital letters.”

’374 Patent, 14:46-51

In Intra Coding, A Block Is Coded Using Pixels In Neighboring Blocks

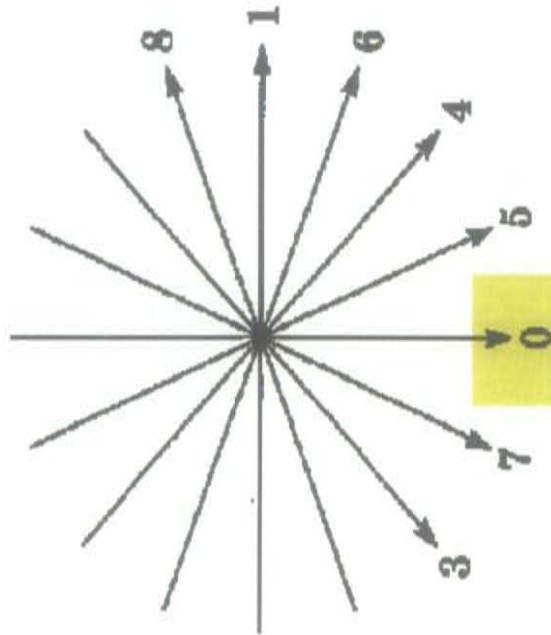
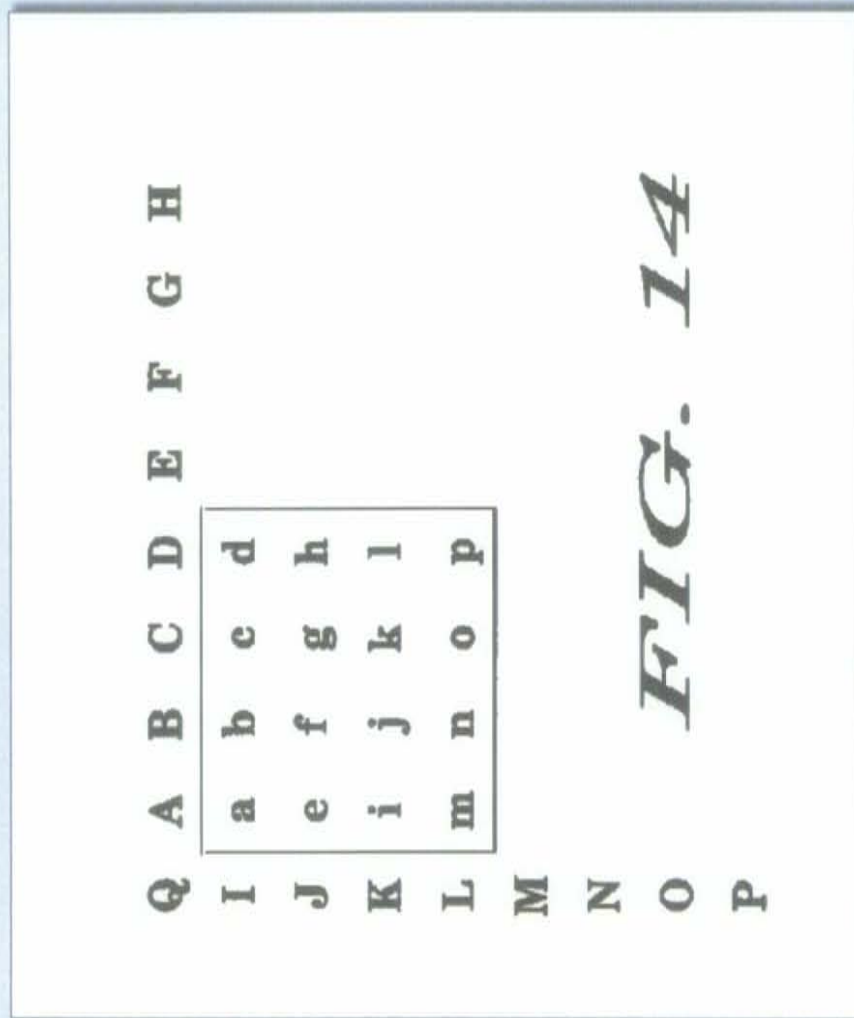


FIG. 15

“As shown in FIG. 15, there are nine different prediction directions for intra_{4x4} coding. They are vertical (0), horizontal (1), DC prediction (mode 2), diagonal down/left (3), diagonal down/right (4), vertical-left (5), horizontal-down (6), vertical-right (7), and horizontal-up (8). DC prediction averages all the neighboring pixels together to predict a particular pixel value.”

’374 Patent, 14:51-57

Intra Coding: VERTICAL Intra Prediction (Mode 0)



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FRAME

1



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The '376 Patent Claims Are Directed To The MBAFF Invention Together With Scanning Paths

United States Patent
Wang et al.

Patent No.: US 7,310,374 B2
Date of Patent: Dec. 18, 2007

0000-0001-9000-0000

These standards as a frame, the experimentals can be further divided into the smaller blocks of FGR. And there are the general problems with various measurement techniques.

[illegible]

Several authors have used the term "cognitive map" to refer to the mental representation of the spatial environment. In the present study, we will use the term "cognitive map" to refer to the mental representation of the spatial environment. In the present study, we will use the term "cognitive map" to refer to the mental representation of the spatial environment.

[illegible]

the fact that the observed positive link between reproductive effort and the probability of being infected by *T. gondii* is not observed in all populations. For example, in the population of *D. dentissima* from the Great Lakes, the probability of being infected by *T. gondii* was not related to the number of eggs laid (19). In the population of *D. dentissima* from the Great Lakes, the probability of being infected by *T. gondii* was not related to the number of eggs laid (19). In the population of *D. dentissima* from the Great Lakes, the probability of being infected by *T. gondii* was not related to the number of eggs laid (19).

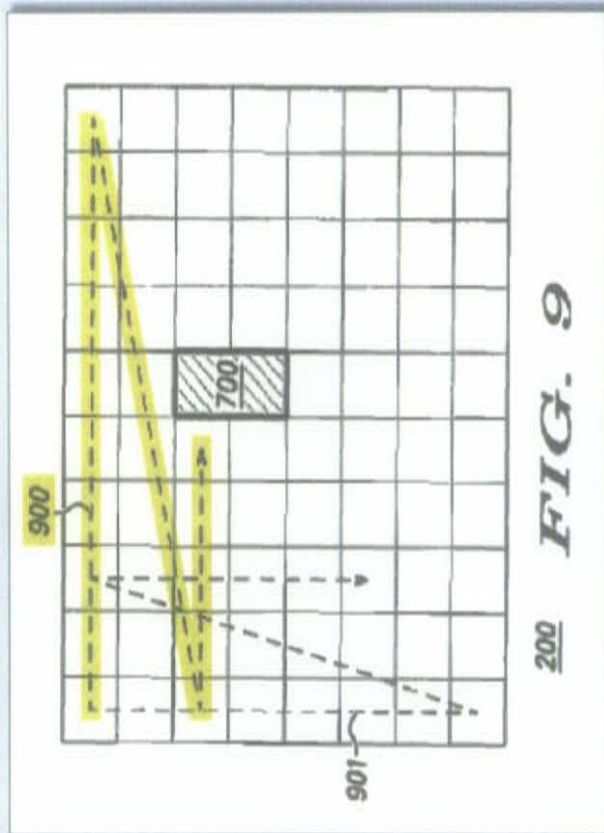
“According to an embodiment of the present invention, in the AFF coding of pairs of macroblocks (700), there are two possible scanning paths. A scanning path determines the order in which the pairs of macroblocks of a picture are encoded.”

2374 Patent, 8:1-5

Two Possible Scanning Paths: Horizontal And Vertical

"FIG. 9 shows the two possible scanning paths in AFF coding of pairs of macroblocks (700). One of the scanning paths is a horizontal scanning path (900). In the horizontal scanning path (900), the macroblock pairs (700) of a picture (200) are coded from left to right and from top to bottom, as shown in FIG. 9. The other scanning path is a vertical scanning path (901). In the vertical scanning path (901), the macroblock pairs (700) of a picture (200) are coded from top to bottom and from left to right, as shown in FIG. 9."

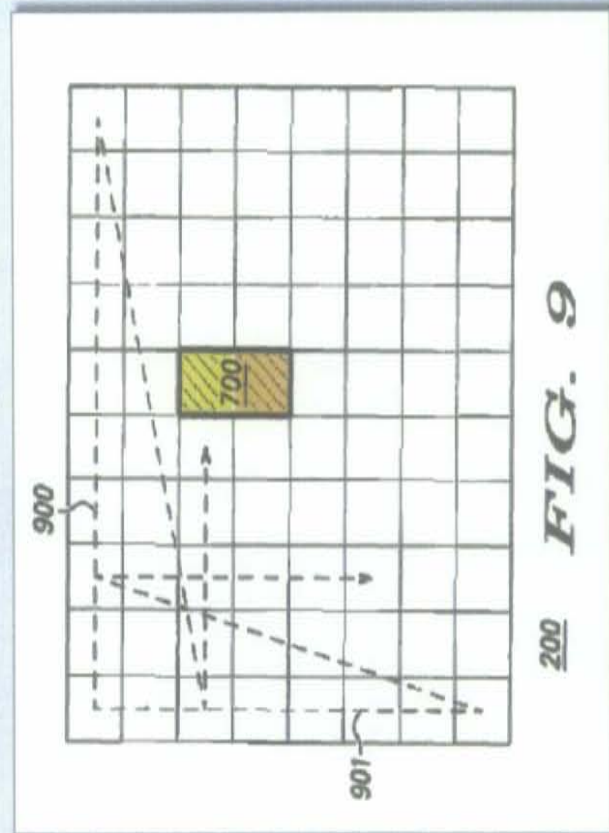
'374 Patent, 8:5-14



Horizontal And Vertical Scanning Paths For A Macroblock Pair

“For *frame mode coding*, the top macroblock of a macroblock pair (700) is coded first, followed by the bottom macroblock. For *field mode coding*, the top field macroblock of a macroblock pair is coded first followed by the bottom field macroblock.”

374 Patent, 8:14-18



**This concludes the video coding
technology tutorial submitted by Motorola.**

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